A NEW METHOD IN THE ANALYSIS OF RETAIL

Martin Mecera

Doctoral Degree Programme (2), FIT BUT

E-mail: xmecer00@stud.fit.vutbr.cz

Supervised by: Vladimír Bartík

E-mail: bartik@fit.vutbr.cz

Abstract: The paper proposes a new method of studying retail market. It is called Index of merchant’s activity. The index builds on the knowledge of the theory of efficient markets. It is given into context with methods of studying commodity markets. The usefulness is seen in the possibility of revealing strategy of individual competitors. There is an example of using the index in warehouse management.

Keywords: EEICT, retail, market, analysis

1. INTRODUCTION

There are a few markets where goods are sold before the customer gets a final product. Commodity exchange, wholesale and retail are the most important. Each market has special properties which is why the tools for its studying differ.

In commodity markets, the changes in commodity prices are instantly visible for all world. They are automatically recalculated by exchange as soon as the ratio between supply and demand changes. There are two concepts for study of commodity markets: Technical and fundamental analysis. The technical analysis predicts future prices from historical prices and volume. The fundamental analysis performs the prediction on the basis of expert knowledge. Both of them suppose that the market is efficient. Efficient market is one in which there are large number of equally informed, actively competing people attempting to maximize profits. In such a market, at any moment, price reflects all available information, as well as all events expected to occur in the foreseeable future [1].

Whereas, the commodity market is centralized at the exchange, the retail is decentralized. The price varies among merchants. The retail does not comply with the definition of efficient market. There is not a large number of sellers and buyers in most cases. The buyers also do not act fully rationally on the market. For example some buyers orient themselves according to advertisement instead of to their needs. On the other hand, sellers do not react on competitors‘ price immediately. It follows that the (mean) price in retail does not always reflect all available information.

Although the retail is not as efficient as commodity market, some economical laws hold for both of them. Important role plays the equilibrium price. It is the price at which the quantity of a good demanded equals the quantity of that good supplied [2]. The price moves faster toward the equilibrium price on the efficient market than on the less efficient one. Examples of this phenomenon will be given further in this paper. It will be shown that the merchant who is aware of this market behavior can gain greater profit.

2. THE (IN)EFFICIENCY OF RETAIL

The retail has changed significantly since the income of internet shopping. Prices among e-shops can be compared faster than among common shops. Web sites that specialize in e-shop price comparison act as a centralization layer over the decentralized market. The behavior of customers is changing too – they demand the lowest price found on these price aggregators. All of these factors support the grow of retail efficiency. The behavior of price moves is demonstrated on charts 1-3 of LED TVs with 40-inch screen (data source: [3]).

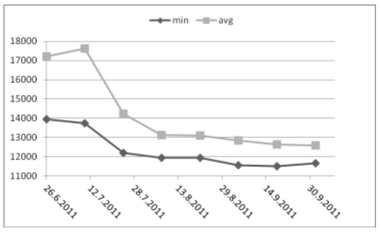

Chart 1: Prices of Samsung UE40D5000.

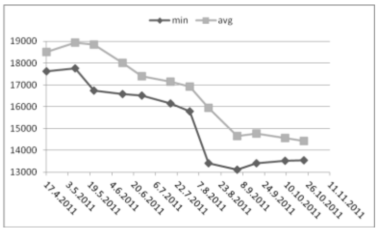

Chart 2: Prices of LG 42LV5500.

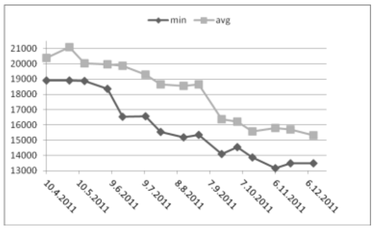

Chart 3: Prices of Philips 40PFL6606H.

The data on charts show minimum and average prices since placing the product on market until the minimum prices stabilize near the equilibrium price and continue on this level into the future. (It can be observed, that the average price stabilized at the same time when the minimum price stabilized). The efficiency of these markets was different – consider the time since placing the product on market until price stabilized at equilibrium. Samsung needed 42 days (26.6.-7.8.2011), LG needed 175 days (17.4.-9.10.2011), Philips needed 224 days (10.4.-20.11.2011).

The minimum price (equilibrium) can be precalculated: It is the sum of the wholesale price and handling costs. If the merchant offers a product with minimum price on highly competitive market, he should earn no profit in theory [4]. The market with TVs was chosen, because it is assumed to be very competitive. However, the average price of any TV did not equal to minimum price. It is because, many merchants are not willing to cut their profits at all costs.

3. TRADING ON INEFFICIENCY

To maximize profit, the merchant needs to sell as many products with greatest profits as possible. He has to select products that will be hold on stock. It is natural to hold less quantity of a product if its price is in risk of fast fall. Proof: If he can choose another product with the same size and customer demand but with less risk of price fall, he earns more than with product with riskier price. The steepness of price fall can be seen as the expression of efficiency of the market with this product. It is assumed in this paper that the size of competitors‘ activity increases the efficiency which in turn accelerates the price fall.

The proposed method of prediction of the steepness of price fall is the rate of competitors‘ activities. An activity of one competitor is measured as the time he keeps his price close to market minimum. The advantage of this rate is its simplicity of data collection.

Following example demonstrates the activity of a hypothetical merchant M1 on the market of product P. The effort of M1, to keep his price on global minimum, is shown in the chart 4. Histogram on chart 5 shows, how successful he was. He pushed the price lower for most of the time.

day	min.	M1
1.	100	100
2.	90	90
3.	80	80
4.	70	80
5.	60	80

Table 1: Prices of product P.

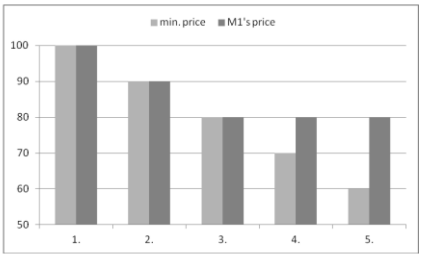

Chart 4: Comparison of min. price and M1's price in individual days.

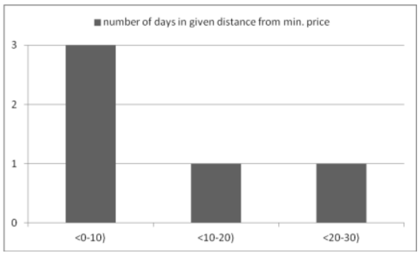

Chart 5: Histogram of the activity of merchant M1.

The index of activity $A_M(P)$ of one merchant M on the market of product P can be expressed as an average distance of his price from minimum market price over time (see exp. 1).

$$A_M(P) = \frac{1}{|days|} \sum_{d \in days} price_M(P,d) - price_{\min}(P,d) \qquad (1)$$

The $price_M(P,d)$ is the merchant M's price of product P in a day d. The $price_{min}(P,d)$ is the minimum price of product P on the market in a day d.

The index $A_M(P)$ lowers as the merchant's price moves closer to market minimum. The aggressive competitors (keep their prices low) have low values of $A_M(P)$. Weak competitors have larger values. It is most useful to measure the index since the time when the product was placed to the market until the time when the price stabilizes on equilibrium.

3.1. BENEFITS OF WATCHING THE INDEX

It should be noted that the index of merchant's activity is unique for retail. It can not be constructed for commodity or stock market because merchants on commodity market are not known. All parties are anonymous there. It is not possible to monitor the strategy of individual trader in commodity market whereas it is possible in retail for sellers.

The merchant who wants to understand the market can monitor the behavior of his competitors. This should be useful both in long term and short term research.

In the long term research, the merchant can reveal the aggressive competitors on the market. For this purpose he can construct a table of all competitors and products. The cell of the table would contain the value of $A_M(P)$. A data mining process should reveal markets with tough or weak competition from this data. Individual products can be classified into categories of expected strength of competition. The merchant then has the possibility to choose markets where strong competitors do not operate.

In the short term research, the merchant wants to maximize his profit when selling certain product. He can use the knowledge from the data mining step plus current values of $A_M(P)$ to predict the behavior of price move, given the set of competitors and the category of the product. The usefulness of monitoring current values of the index is demonstrated on a system of warehouse management in next section.

3.2. APPLICATIONS

If a merchant wants to sell as many products with greatest profits as possible, he needs to keep his store efficiently loaded. This problem can be viewed as an extension to knapsack problem: Given the size of store and set of products with sizes and profits, return the amounts of products that fit into the store and maximize the profit when sold.

The amount of individual products must be upper bounded by an estimation of customer demand. The research on demand forecast has been studied extensively [5]. The forecast is usually prepared before launching the product on market. It gives the function of customer demand based on the market price. The future market price can be estimated by the activity index A_M of competitors, especially the risk of price fall. An expert's estimation can be used (for example merchant's qualified estimation).

The problem of warehouse management can be formulated as integer linear programming (ILP) task:

Let S be the size of store. Let N be the set of product indexes, $i \in N$, p_i is product's forecasted retail price, w_i is product's wholesale price, $size_i$ is the product's size. The value m_i in the expression 2 is the profit of selling product i at current retail price.

$$m_i = p_i - w_i \qquad (2)$$

The value ub_i in the expression 3 is the upper bound of customer demand of product *i* estimated by the forecast est_i.

$$ub_i = est_i(p_i) \tag{3}$$

The expression 4 sets a constraint of the amount of product *i*.

$$0 \le count_i \le ub_i \tag{4}$$

The expression 5 says that there can not be more products in the store than the size of whole store.

$$\sum_{i \in N} count_i * size_i \le S \tag{5}$$

The expression 6 is the objective of ILP task. Its task is to maximize the profit in bounds of expressions 2, 4 and 5.

$$\text{maximize} \sum_{i \in N} count_i * m_i \tag{6}$$

As the byproduct, the ILP task returns the amounts of products ($count_i$) that should be loaded into the store. Note that the equation 3 is calculated separately from the ILP task. The values of ub_i go to the ILP task as constants. In real applications, the constraint 4 can be extended to account on previous supplies on stock.

4. CONCLUSION AND FURTHER WORK

The paper introduced a method of retail analysis. It is unique for retail, because it builds on the knowledge that the identity of sellers is known. Sellers' actions can be individually tracked over time. The data for the analysis can be collected freely on internet.

Further work can concentrate on development of a data mining techniques that would use the indices of merchant's activities to exploit opportunities on certain markets.

ACKNOWLEDGEMENT

This article was supported by the grant FIT BUT FIT-S-11-2.

REFERENCES

[1] Teweles, R., J., Jones, F., J.: The Futures Game. Boston, MA, McGraw Hill, 1999, ISBN 0-07-064757-7

[2] Krugman, P., Wells, R.: Microeconomics, second edition. New York, NY, Worth Publishers, 2009, ISBN 0-7167-7159-4

[3] Heureka! [online]. [cit. 2012-02-23]. available on-line: <http://www.heureka.cz >

[4] Osborne, M., J., Rubinstein, A.: Bargaining and Markets. San Diego, CA, Academic Press, Inc., 1990, ISBN 0-12-528631-7

[5] Armstrong, J., S., Green, K., C.: Demand Forecasting: Evidence-based Methods. In: Strategic Marketing Management: A Business Process Approach, United Kingdom, Cengage Learning EMEA, 2009, ISBN 1844800008, available on-line: <http://www.buseco.monash.edu.au/depts/ebs/pubs/wpapers/2005/wp24-05.pdf>